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EDITORIAL

Special issue on vehicles as sensing devices: from observations to actionable insights

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1 Introduction

With the development of sensing and wireless communication technologies, recent years have witnessed a wide spectrum of vehicles including taxis, buses and logistical vans, equipped with a number of pervasive devices (e.g., GPS antennas, radar, camera, personal smartphones). As a result, they are able to continuously report their visiting positions and driving status to the data center at a reasonably temporal and spatial resolution. This data possesses unique and valuable characteristics, such as ubiquitousness, continuousness, large-scale and good coverage in both space and time. Hence, the sensor-equipped vehicles on the road surfaces are able to become one kind of powerful yet cost-efficient device for urban sensing tasks, especially for those sensing objects with strong spatiotemporal dynamics in the city. Generally, the sensing tasks can range from real-time traffic road conditions to operation behaviours of vehicle drivers.

It has been well-recognized that the data massively sensed by vehicles can provide rich opportunities to enable promising smart applications for easing individual life, recommending personalized services, as well as facilitating city development. Despite the wealth of the data, a sustainable gap still exists between the data observations and the actionable insights when building smart cities, posing fundamental challenges on the techniques and applications. To narrow the gap, data analytical techniques are the necessity and also the key enablers. Challenges also arise when developing new methods and techniques, including algorithm effectiveness, computation speed, energy efficiency, user privacy, server security and system scalability.

This special issue aims to present the state-of-the-art research achievements in addressing the above-mentioned challenges in converting the pervasive observation data to actionable insights, especially in the context of moving vehicles. After two rounds of review processes, 9 papers were accepted, and they have been carefully revised according to the reviewers and Guest Editors' feedback. The guest editors wish that this collection of papers can provide a clear picture of the studies on using vehicles as sensing devices to researchers in the field of Ambient Intelligence and Humanized Computing.

2 Contributions of this special issue

Nine accepted papers in this special issue present researchers' efforts from different perspectives, including data issues, applications, and so on.

Abul et al.'s paper entitled "Can driving patterns predict identity and gender?" (Abul and Karatas 2019) studies the question of whether machine learning techniques are a real threat to driver re-identification from published CAN (controller area network) bus driving data. Specifically, in this study, the authors established several machine learning models for the drivers' gender and identity prediction. Experimental results show that the gender prediction classifiers can achieve 0.97 accuracy rate; and the driver identity classifiers can achieve 0.1 accuracy rate for 105-class and

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0.98 accuracy rate for 2-class driver identification tasks. Such results demonstrate that driving patterns may indeed act as quasi-identifiers. Finally, the authors suggested that the dissemination of driving data should be done according to non-trivial data privacy protection procedures.

Wang et al.'s paper entitled "An optimization model for the transportation network with hierarchical structure: the case of China Post" (Wang et al. 2019) focuses on the vehicle routing problem of China Post Group with time windows (VRP CPG TW). The authors established a three-level hub model, including the determination of the number, location of hubs and their service area, and the routes between hubs and local post office. Then they integrated the center distribution method and the Taboo and Genetic algorithm to solve the VRP CPG TW. Compared with the real scheme of Guizhou Post, their scheme achieves 25% decrease in operation fee. Hence, the authors said the proposed model might be able to optimize the transportation network of China Post.

Luo et al.'s paper entitled "A moving energy-based routing in DTNs with speed heterogeneity" (Luo et al. 2019) mainly focuses on the data forwarding problem in the delay tolerant networks (DTNs) with speed heterogeneity (DFSH). To be more specific, based on the moving energy concept, the authors proposed a moving energy based routing algorithm with speed heterogeneity (MRSH) which takes the nodes with higher moving energy to forward data packets. At last, the authors performed extensive simulations and evaluate the performance of MRSH. Results show their model can achieve significant improvement in the delivery ratio and reduce the delivery delay.

Rao et al.'s paper entitled "Distracted driving recognition method based on deep convolutional neural network" (Rao et al. 2019) focuses on the identification of drivers' distracted driving behaviours. Specifically, the authors employed the deep convolutional neural network to identify the distracted driving behaviours from the driving image data captured by the in-vehicle camera. Experimental results show that the proposed deep model can achieve 97.31% identification accuracy. This study is meaningful for the driving assistance system to avoid potential safety risks.

Zhang et al.'s paper entitled "A differential privacy based probabilistic mechanism for mobility datasets releasing" (Zhang et al. 2020) focuses on the privacy protection of the mobility datasets releasing. The mobility datasets can reveal multiple sensitive location information. Authors proposed a novel differential privacy based probabilistic mechanism to generate the privacy preserved population distributions from mobility datasets. Additionally, the proposed method also satisfies differential privacy, so that users are able to navigate the privacy level.

Yang et al.'s paper entitled "Persistent transportation traffic volume estimation with differential privacy" (Yang et al. 2020) also focuses on the privacy issue. The authors founded that few of the existing traffic estimation studies concerned about the privacy issue. To narrow the gap, they presented schemes with differential privacy for estimating the persistent point/point-to-point/multi-point traffic volume. The key technique is encoding the passing vehicles in privacy-preserving data structures with the random communications between vehicles and road-side units (RSUs).

Zeng et al.'s paper entitled "RRCF: an abnormal pulse diagnosis factor for road abnormal hotspots detection" (Zeng et al. 2019) presents a novel road abnormal hotspots detection method by using taxi GPS data. Specifically, the authors employed a region real-time congestion factor which has a relationship with the real-time traffic data, to detect abnormal hotspots. The evaluation experiments based on two accidental scenarios have demonstrated the effectiveness of the proposed method. This study can also benefit the path planning and traffic management.

Cheng et al.'s paper entitled "Data recovery in wireless sensor networks based on attribute correlation and extremely randomized trees" (Cheng et al. 2019) presents a novel data recovery algorithm for the wireless sensor networks based on the extremely randomized trees (ACET) and the attribute correlation which is usually ignored in existing studies. Authors employed the Spearman's correlation coefficient to model the correlation between different attributes, then utilized the trained model to recover the lost data. Experimental results show that the correlation between attributes can improve the effectiveness of data recovery compared with other methods.

Xiao et al.'s paper entitled "Efficient fog-assisted heterogeneous data services in software defined VANETs" (Xiao et al. 2019) focuses on the low-performance problem of data services in heterogenous vehicular ad hoc networks (VANETs). To enhance the performance, this paper presents a novel system architecture integrated with software defined network, fog computing and a dedicated algorithm for cooperative data services. Based on the new service architecture, to minimize the service delay, a problem called fog-assisted heterogeneous data services (FAHDS) is formulated and solved by a greedy algorithm. Finally, the effectiveness of the proposed methodology was demonstrated by a comprehensive simulation.

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